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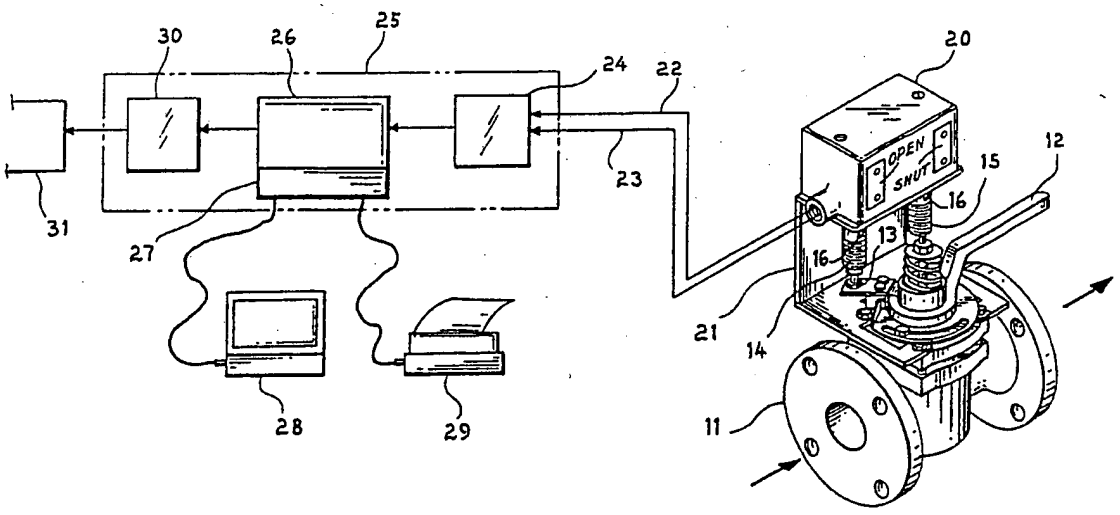
(54) Title: VALVE POSITION MONITORING SYSTEM



(57) Abstract

A quarter turn valve (11) fitted with one or more targets (13) mounted on its actuating means and fitted with a pair of proximity sensors (14, 15) one of which generates a signal when the valve is open and the other of which generates a signal when the valve is closed.

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TITLE

VALVE POSITION MONITORING SYSTEM

Cross Reference to Related Application

This application is a continuation-in-part of application Serial No. 134,879, filed December 18, 1987.

Field of the Invention

The present invention relates to a position indicator for manually operated valves enabling the position of such valves to be monitored from a remote location. More particularly, this invention relates to a system retrofitted to a quarter-turn valve to indicate whether the valve is in the open or closed position.

Background of the Invention

The chemical process industry utilizes actuator operated and manually operated valves to control the flow of fluid. In quarter-turn valves, the open-to-close positions are achieved with a 90 degree movement of the component that interrupts flow within the valve assembly. Valve position monitoring by controlling equipment is becoming more necessary for precise control of the processes. Valve position monitors are typically mechanically operated electric switches which are physically mounted on the valves. The switches are triggered mechanically with devices mounted on the valve mechanisms, and communicate with the controlling equipment via different electric signals depending on valve position.

U.S. Patent 4,406,303 discloses a gate valve with a position indicator in which a trip spring 110 makes contact with sensing faces 101 and 106 of proximity sensors 100 and 104 respectively to make electrical contact and energize the electrical circuit

shown in block diagram (Fig. 6) to actuate an indicating lamp which indicates the position of the valve. However, in this device a linear actuated valve is used. Moreover, the position indicator must be attached to a valve stem extension.

U.S. Patent 3,602,254 discloses a valve position indicating system including magnetically conductive material embedded in a stub shaft and a pair of pole pieces with electrical windings connected to AC power and a meter, respectively. Depending on the position of the valve, the magnetically conductive material induces a greater amount of current in one winding over the other, and the current to the winding connected to the meter indicates valve position. However, this device will register "zero" irrespective of whether the valve is closed or whether there is a power failure. In other words, it gives no true live indication of valve position when the valve is in the "zero" or closed position. In addition, it requires mounting the magnetically conductive material to the shaft of the valve and encasing the valve in a housing.

It is an object of the present invention to provide a valve position monitoring system that can be retrofitted to existing quarter-turn valves. It is a further object of the present invention to provide a means to indicate whether such a valve is open or closed, both at the valve and at a remote control system. It is a feature of the present invention to provide a valve position monitoring system with components that are not frictionally engaged. An advantage of the present invention is that it provides a monitoring system for those valves which cannot be removed from a piping system because of the loss of production time or replaced with expensive new valves

equipped with a monitoring device. These and other objects, features, and advantages will become apparent upon review of the following description of the invention.

Summary of the Invention

The present invention concerns a valve position monitoring system for a valve having an actuating means adapted to open and close the valve in a quarter turn. The system comprises one or more targets secured to the actuating means, and first and second proximity sensors secured to the valve and adapted to generate signals. The first proximity sensor is aligned to detect a target and generate a signal when the valve is closed, and the second proximity sensor is aligned to detect a target and generate a signal when the valve is open.

Brief Description of the Drawings

Figure 1 is a perspective view of a quarter turn valve retrofitted with the valve position monitoring system, and a schematic view of the circuitry used with this system.

Figure 2 is a perspective view of another quarter turn valve retrofitted with an alternative embodiment of the valve position monitoring system.

Detailed Description of the Invention

Referring now to Figure 1, a quarter turn valve fitted with the sensor system of the present invention is shown generally as 11. Fluid flows through the bore of the valve 11 in the direction indicated by the arrows. The valve is manually actuated by turning handle 12. The valve is shown in the open position and target 13 is shown positioned under proximity sensor 14. Proximity sensor 15 is positioned to detect the presence of target 13 when valve 11 is in the closed position. Proximity sensors

14 and 15 may be fitted with light emitting diodes 16 which visually indicate the position of the valve. Proximity sensors 14 and 15 are mounted on housing 20 which in turn has been mounted on valve 11 by means of bracket 21.

Proximity sensor 14 emits a signal through line 22, and proximity sensor 15 emits a signal through line 23 to signal input receiver 24 in control system 25. The proximity sensors 14 and 15 communicate with the control system 25 by one of two methods. In the first method, signal input receiver conditions the signals received from proximity sensors 14 and 15 and forwards the conditioned signal to central processing unit (CPU) or control device 26 fitted with communication system 27 adapted to relay the signal to status indicating units such as cathode ray tube (CRT) or viewing device 28 fitted with a keyboard and printer 29. The signal is sent from CPU 26 to output 30 which conditions the signal to a form suitable to feed to process safety interlock 31. In the second method, the signals are received from the proximity sensors 14 and 15 by an amplifier, and forwarded to a relay contact output. The relay contact output may be any of several means to notify an operator of a particular valve position, including a light panel, a bell or whistle, and the like.

Figure 2 represents an alternative embodiment of the present invention. In this figure, a different type of quarter-turn valve is fitted with this alternative sensor system of the present invention as shown generally at 11. Fluid again flows through the bore of the valve 11 in the direction indicated by the arrows. The valve 11 is fitted with proximity sensors 14 and 15 (mounted on housing 20) by means of bracket 21. The valve is manually actuated

by a handle that fits over the extension 17 and grease fitting 18. The valve is shown in the open position and target 13 is shown positioned under proximity sensor 14. A total of four targets 13 are secured to the actuating means and extend radially from the central axis of the actuating means. The targets 13 are placed at 90 degree intervals around the circumference of the actuating means, in alternate locations axially along the surface of the actuating means. Thus, the targets alternately coincide with the location of proximity sensors 14 or 15. When one target 13 is detected by a proximity sensor 14 or 15, an adjacent target 13 is not detected by the other proximity sensor 14 or 15. Thus, the invention of Figure 2 eliminates the possibility of improper installation of the actuating means together with plurality of targets 13. Should an operator install the actuating means backwards within the valve (180 degrees turned around) targets 13 will still be detected by the proximity sensors 14 and 15. Furthermore, irrespective of whether the operator rotates the actuating means a quarter turn clockwise or counterclockwise, a target 13 will be detected by one of the proximity sensors 14 or 15. The proximity sensors 14 and 15 of Figure 2 communicate with the control system 25 schematically depicted in Figure 1 as previously described.

There are two varieties of proximity sensors that are useful in the practice of this invention. Moreover, each type of proximity sensor has specific requirements relative to the type of target that it can detect. The first type of proximity sensor is the eddy current killed oscillator ("ECKO") type proximity sensor. As known to those skilled in the art, this type of proximity sensor operates with RF signals. It

can be used in conjunction with targets containing any metal. These targets may contain magnetic or non-magnetic metal. Examples of metals useful for targets with this proximity sensor include cast iron, mild steel, stainless steel, brass, aluminum, and copper. Eddy currents in the metallic materials present a reflected load to a radio frequency oscillator within the ECKO sensor, reducing its signal level. This changes the voltage output of the sensor.

The second type of proximity sensor is the Hall effect type proximity sensor. It can only be used with targets containing magnetic metal. When subjected to a magnetic field, the unit responds with an output voltage proportional to the magnetic field strength. A Hall effect type proximity sensor is a semiconductor crystal device through which a constant current is passed. This current exhibits no output voltage difference when magnetic material is absent. With magnetic material present, a magnetic force is exerted on the current in the semiconductor portion of the device. This force disturbs the current distribution in the sensor resulting in a voltage difference across the output.

A main feature of the present invention is the small non-contact proximity sensor which detects the valve position without touching the moving part of the valve. There is no metal-to-metal contact, wear, or friction to overcome. Another important feature of the subject invention is that in the event of a power failure, it will not register an open or close position on any display. Other systems for example utilize meters that indicate "0" or "100" depending on valve position. In such systems, an operator would not be aware of a power loss, as the meter would register zero. In contrast, the present invention is

fail-safe to the extent that should the system lose power no signal is forwarded to the control system 25 and the light emitting diodes 16 will not be lit; an operator will then know that power is lost to the system.

The microprocessor-based proximity sensor does not contain mechanical contacts as with conventional switches. This feature overcomes contact bounce common with mechanical contacts. Contact bounce will cause erroneous signals in a control system.

The invention is particularly useful with two specific quarter-turn valves, the DeZurik plug valve and the Rockwell-Nordstrom plug valve. Each of these valves has an actuating means external to the valve that is readily adaptable for securing the targets 13 thereto. The DeZurik plug valve is shown in Figure 1 and is a non-lubricating valve. The Rockwell-Nordstrom plug valve is shown in Figure 2 and is a lubricated valve with a grease fitting affixed to the actuating means to dispense lubricant. Prior to the present invention, these two types of valves could not be retrofitted with monitoring systems because of the interference of the wrench operator handle and/or the grease fitting. These valves may now be readily equipped with the system of the present invention, which is small in overall size and attaches to either valve 11 by bracket 21 with ease.

The invention also finds utility in certain varieties of other quarter-turn valves, including the ball valve and the butterfly valve.

Changes and modifications in the specifically described embodiments can be carried out without departing from the scope of the invention

which is intended to be limited only by the scope of the appended claims.

Claims

1. A valve position monitoring system for a valve having an actuating means adapted to open and close the valve in a quarter turn, the system comprising one or more targets secured to the actuating means, and first and second proximity sensors secured to the valve and adapted to generate signals, said first proximity sensor aligned to detect a target and generate a signal when the valve is closed, said second proximity sensor aligned to detect a target and generate a signal when the valve is open.

2. The valve position monitoring system of Claim 1 wherein said proximity sensors are eddy current killed oscillator type proximity sensors and said targets contain metal.

3. The valve position monitoring system of Claim 2 wherein the metal contained in said targets is magnetic.

4. The valve position monitoring system of Claim 2 wherein the metal contained in said targets is non-magnetic.

5. The valve position monitoring system of Claim 1 wherein said proximity sensors are Hall effect type proximity sensors and said targets contain magnetic metal.

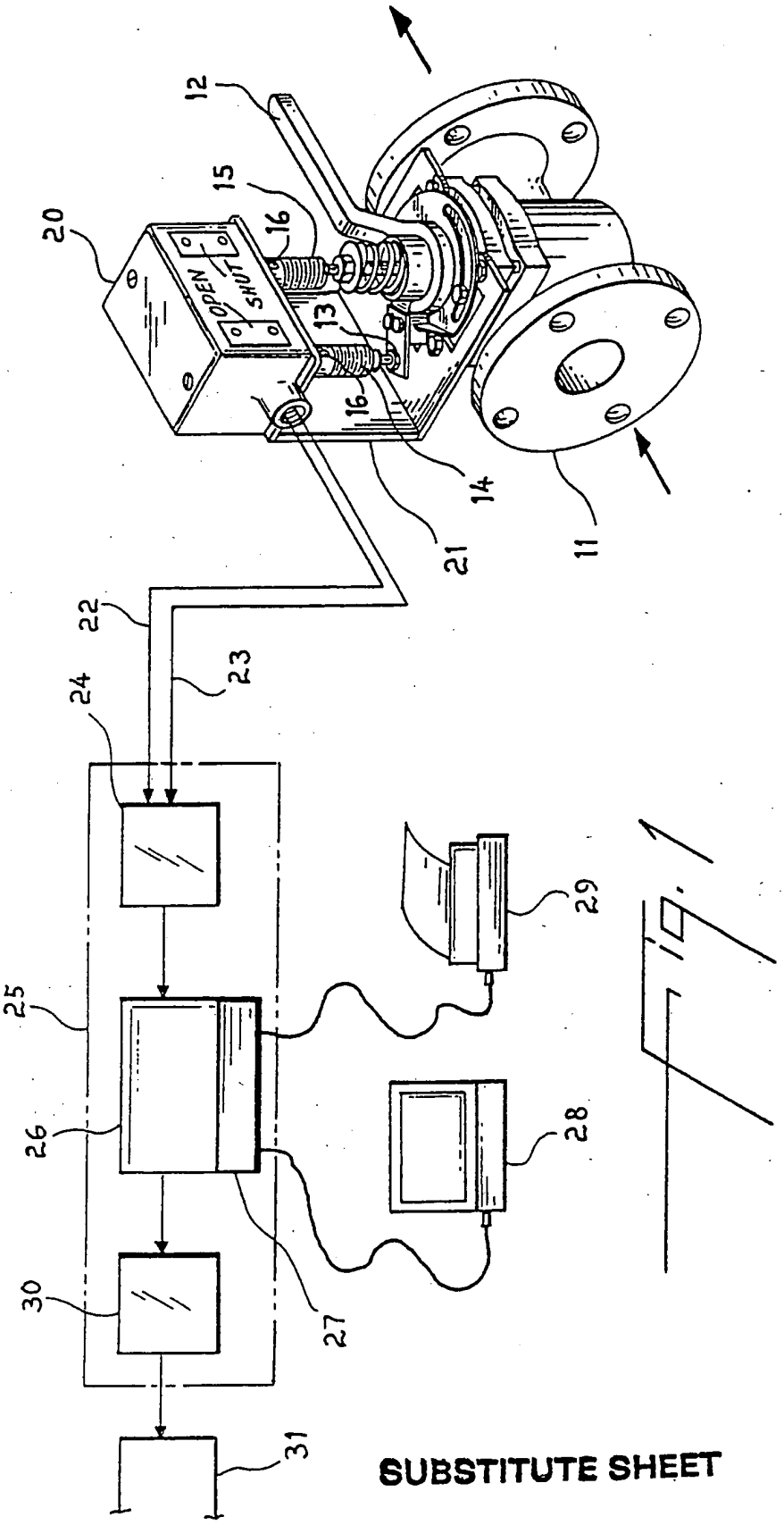

Fig. 1

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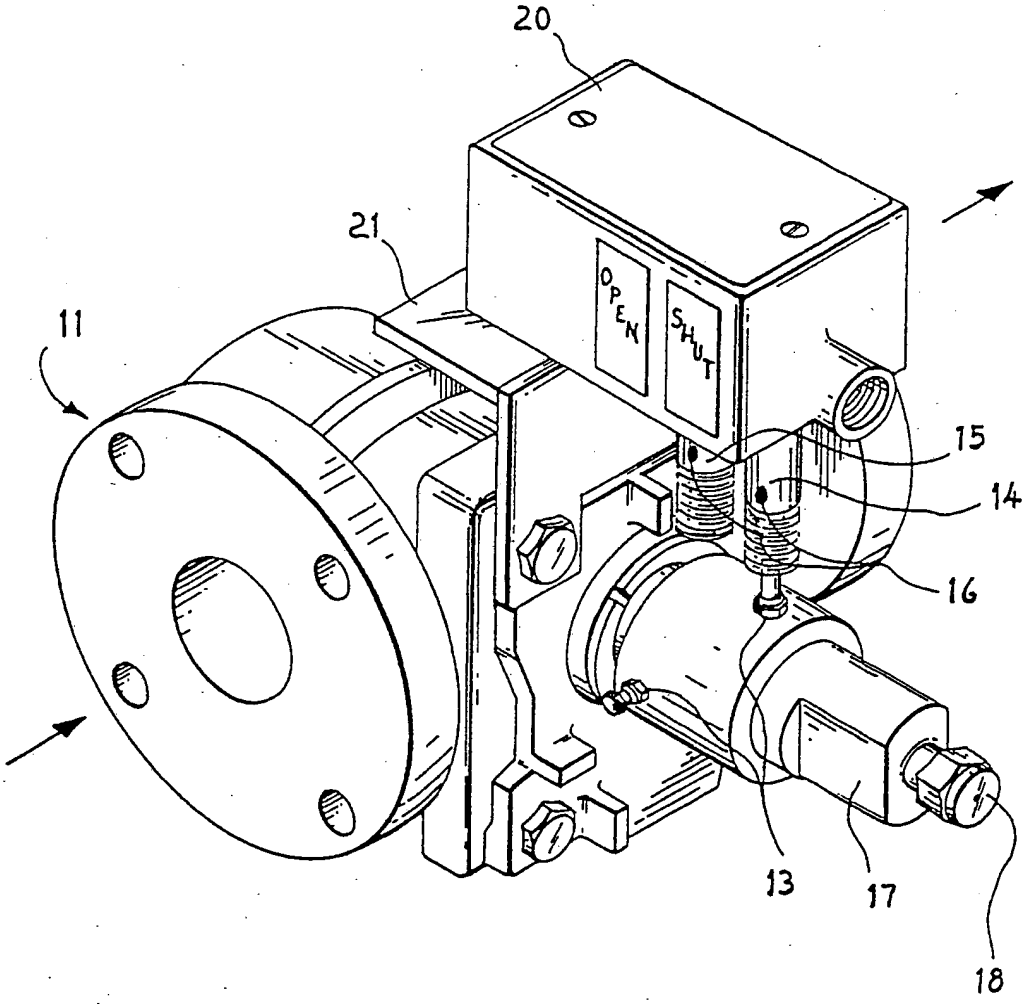
Fig. 2



INTERNATIONAL SEARCH REPORT

International Application No. PCT/US 88/04442

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(4) F 16K 37/00
U.S. CL 137/ 554

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
U.S.	137/554,556

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US, A, 4, 156,437, (CHIVENS) 29 MAY 1979, See entire document. See column 4, lines 24+.	1-4
A	US, A, 4,227,547, (CAMERON) 14 OCTOBER 1980, See entire document	1-5
A	US, A, 4,299,251, (DUGAS) 10 NOVEMBER 1981, See entire document	1-5
X	US, A, 4,601,211, (WHISTLER) 22 JULY 1986, See entire document	5

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IV. CERTIFICATION

Date of the Actual Completion of the International Search

09 MARCH 1989

Date of Mailing of this International Search Report

International Searching Authority

ISA/US

Signature of Authorized Officer

A. MICHAEL CHAMBERS